

ing the summer than they did in the winter. However, since the figures provided for summer and winter rates were the mean of two and four measurements, respectively, chosen from variable data, I do not think their conclusion is justified. Figure 3 presents the measurements that I obtained at sufficiently small time intervals to indicate seasonal growth. Given the variability in growth rates and sparseness of the data, no differences between seasons can be detected.

Leighton and Boolootian conclude that "The rate of growth of *H. cracherodii* is approximately 20 mm per year for the middle one-third size class (50–100 mm shell length). First year growth may average 26–30 mm. A specimen 50–55 mm in shell length is 2 years old if living under ideal conditions. Growth rate drops considerably as abalone grow larger than 130 mm." Since I obtained no data for animals less than 30 mm long, I cannot comment on growth in the first year. The average growth rate that I measured for animals 50 mm and less was 14.78 mm per year. At this rate an abalone would need about 1.4 years to grow from 30 to 50 mm, a figure that is consistent with Leighton and Boolootian's. However, I consider that the 20 mm per year estimated by Leighton and Boolootian for animals from 50–100 mm long is too high. In this study, animals that were between 51 and 80 mm long averaged 14.64 mm per year. At this rate an abalone would need approximately 2.7 years to grow from 40 to 80 mm. The growth rate seems to slow down between 80 and 90 mm

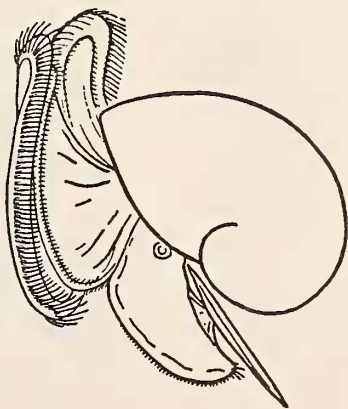
rather than at 130 mm. The average rate measured for animals from 90–150 mm was 0.78 mm per year. At this rate an animal would need about 51 years to grow from 90 to 130 mm.

The mean rates measured for the animals in each 10 mm size interval (e.g. 41–50, 51–60 mm, etc.) are presented in Figure 4. Since all the rates measured for the 121–130 mm interval were zero, there is no standard error. The standard errors for animals less than 90 mm long are large. The standard errors for the animals larger than 90 mm are smaller because most of the animals did not grow significantly. Therefore, even though the standard errors are relatively small, if and when an animal will grow cannot be predicted.

It should be remembered that the growth rate is an average for the population. Different animals of the same size may grow at vastly different rates (Figures 1 and 2); the same animal may grow at different rates at different times (Figure 3). In other words, the age of a particular abalone cannot be determined, with any certainty, from its size.

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Aspidosiphon schnehageni (Sipuncula) inhabiting *Tornatina* Shells

BY

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(4 Text figures)

INTRODUCTION

IN THE MONOGRAPH by STEPHEN & EDMONDS (1972), 321 species of sipunculans are listed and described; of these, no less than 27½% are known from only a single specimen, no further occurrence of them being reported. This is also the case for *Aspidosiphon* (*Paraspidosiphon*) *schnehageni* Fischer, 1913, originally found off the Chilean coast.

The present article deals with some undescribed systematic features of the above mentioned species. The specimens were kept for more than 35 years in the collection of the Los Angeles County Museum of Natural History, California, and were given to me for examination by Dr. Eveline Marcus, to whom I am deeply indebted.

DESCRIPTION

Material: Six worms found in empty gastropod shells (*Tornatina*) (Figure 1). One specimen was badly dam-

aged, the other 5 were strongly contracted and twisted. Two specimens were extracted from a single shell.

Provenance: Off San José Point, Guatemala; 13°52'30" N; 91°10'30" W at 21 m (11 fathoms) in black sand; 11 January 1938; No. AHF 770a-38.

External Features: All specimens but one had the introvert fully retracted. The trunk length ranged from 4.5 to 6.5 mm, with a mean diameter of about 1.0 mm.

The anal shield is composed of densely packed and chitinized plates without any apparent arrangement (Figure 2a); in only one specimen is it possible to observe, near the anterior border, 4 or 5 incomplete furrows. At the border of the shield the plates become smaller and rather separated from one another. This shield is roughly triangular in shape.

The caudal shield is lighter than the anterior end. It is also smaller, presenting 14 - 18 incomplete, narrow and

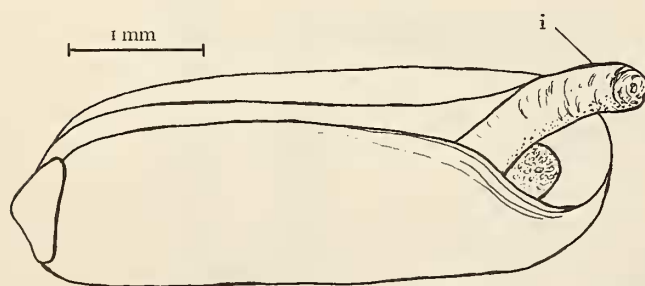


Figure 1

An empty *Tornatina* shell containing a specimen of
Aspidosiphon schnehageni
i - introvert

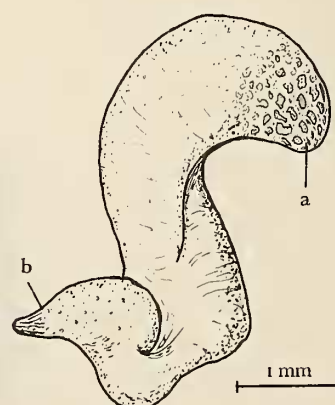


Figure 2

View of an *Aspidosiphon schnehageni*
a - anal shield b - caudal shield

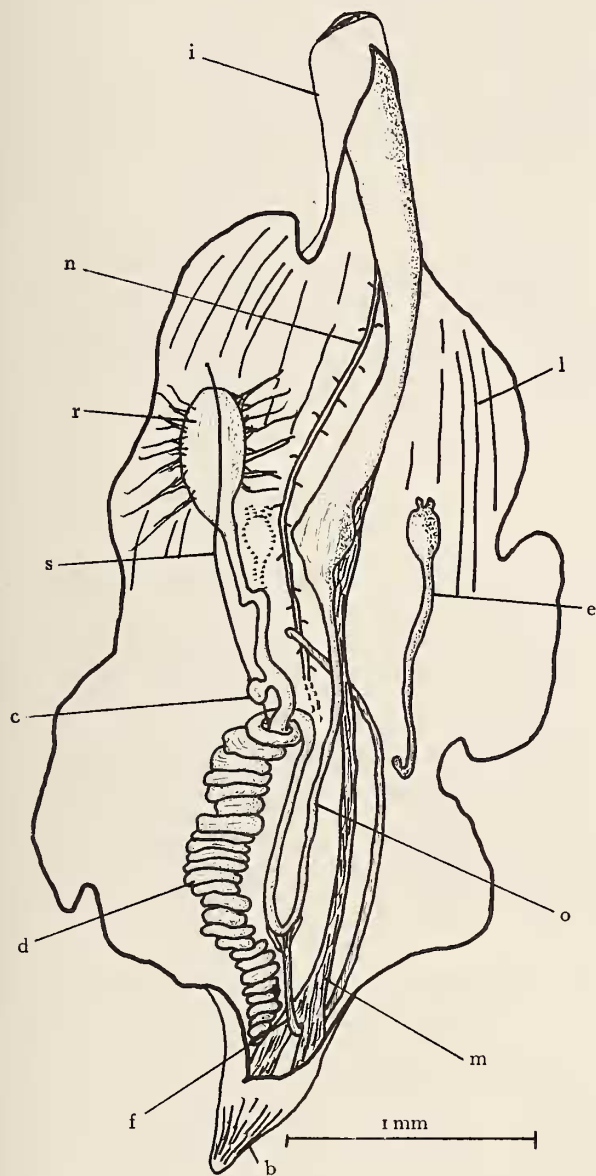


Figure 3

Internal anatomy of *Aspidosiphon schnehageni*

- | | | |
|------------------------------|----------------------|----------------------|
| b - caudal shield | c - caecum | d - alimentary canal |
| e - nephridium | f - fastening muscle | i - introvert |
| l - longitudinal muscle band | m - retractor muscle | |
| n - nerve cord | o - oesophagus | r - rectum |
| s - spindle muscle | | |

shallow grooves. The conical shape of the posterior shield may be a consequence of the gradual tapering towards the hind end (Figures 2b; 3b).

The introvert (Figures 1i; 3i) is about the same size as the trunk and carries single pointed hooks (Figure 4). The hooks are almost triangular in shape with a slight curvature.

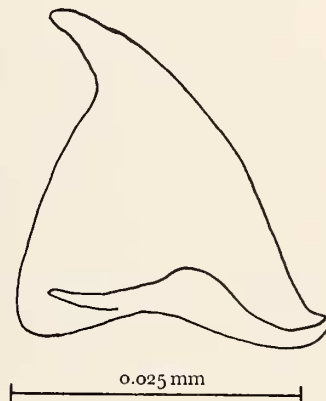


Figure 4

Introvert hook of *Aspidosiphon schnehageni*

Internal Anatomy: The alimentary canal consists of a long oesophagus (Figure 3o), free from the retractor muscle for at least half of its length. From the oesophagus a thin fastening muscle (enlarged in Figure 3f) is attached to the left side of the nerve cord (n) at the level of the anterior half of the body.

There are about 20 (15 - 25) intestinal coils (Figure 3d) and a rounded caecum. The caecum (c) is lodged on the narrow part of the rectum. The rectum's last third is enormously enlarged, presenting a diameter 3 to 5 times that of the preceding segment (Figure 3r). A stout wing muscle holds the rectum, dividing into 3 or 4 muscle bands.

The spindle muscle (Figure 3s) holds the intestinal coils, attaching them to the center of the caudal shield; anteriorly it is fastened in front of the rectum.

Ten to 14 longitudinal muscle bands can be counted in the anterior third of the trunk (Figure 3l); most of this longitudinal muscle sheath is smooth. The muscle bands are more conspicuous on the dorsal side of the trunk.

A strong retractor muscle with 2 broad, confluent roots (Figure 3m) is attached to the posterior end of the body.

Two cream- or slightly rose-coloured nephridia, about half the length of the trunk, are fastened to the body wall for most of their length (Figure 3e); their posterior tips are free, and in 2 worms the tiny mesenteries were ruptured, simulating free nephridia. Both nephridia open slightly behind the anal aperture between muscle bands (2-3) or (3-4), depending on the anastomose considered.

DISCUSSION

of *Aspidosiphon* (*Paraspidosiphon*) *schnehageni*

The species *Aspidosiphon schnehageni* was described by FISCHER (1913) from a single worm dredged off the Chilean coast. The holotype, according to Fischer, was internally damaged, hence important systematic features were not described on that occasion. WESENBERG-LUND (1955) only mentions *A. schnehageni*, adding nothing to the original description, while STEPHEN & EDMOND's 1972 report is a summary of the already short description by Fischer.

The present material was found inside empty gastropod shells, as the holotype. It is composed of animals at least 4 times smaller than Fischer's specimen and thus many of the systematic characteristics are not readily seen in all dissected worms.

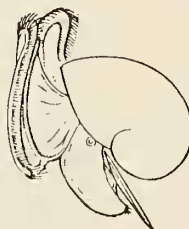
Aspidosiphon (*Paraspidosiphon*) *schnehageni* is easily separated from the other species of this subgenus by its peculiar arrangement of the longitudinal muscle bands,

split into strands in its anterior third. According to CUTLER (1973) the genus *Paraspidosiphon* is to be considered as a subgenus of *Aspidosiphon*, an opinion to which I subscribe. Indeed, a distinction between the two genera based upon a single morphological character, as the presence (in *Paraspidosiphon*) or absence (in *Aspidosiphon*) of individualized muscle bands, is precarious, so much the more so when specimens as *A. schnehageni* and *A. spinalis* Ikeda, 1904, present intermediate features.

The species closest to *Aspidosiphon schnehageni* is *A. levis* Sluiter, 1886, from which the present material can be separated by comparing the number of muscle bands, 21 in *A. levis* and 10-14 in *A. schnehageni*. After examination, part of the material was returned to Mr. Gale G. Sphon of the Los Angeles County Museum of Natural History, Los Angeles, California, U. S. A.

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Ecological Aspects of Zooplankton

(Foraminifera, Pteropoda and Chaetognatha)

of the Southwestern Atlantic Ocean

BY

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(7 Text figures)

INTRODUCTION

THIS WORK PRESENTS the results of the study of the fauna of Foraminifera, Pteropoda and Chaetognatha obtained on two different occasions: July 1973 and January 1974 (Table 1). These collections were made by the Research Vessel *Goyena* (Servicio de Hidrografía Naval, Armada de la República Argentina). I hereby express my gratitude to the above mentioned institution as well as to all those persons involved in collecting the material. Likewise, I specially thank Dr. Esteban Boltovskoy from the Museo Argentino de Ciencias Naturales "B. Rivadavia," Buenos Aires, Argentina, who determined the Foraminifera of the samples and whose help and advice made this work possible.

In actuality the bibliography related to the use of plankters as oceanic hydrologic indicators is very extensive. The majority of the investigators involved with this subject did so based only on one taxon of organisms. Very seldom were two or more taxa included.

The three groups analyzed in this work had been previously (separately) used in this sense, both in world wide order as well as in the zone encompassed by this study (E. BOLTOVSKOY, 1966, 1968, 1970; D. BOLTOVSKOY, 1971, 1973a; D. BOLTOVSKOY & MOSTAJO, 1974). From this point of view Foraminifera is the best group studied. However, nowhere has an attempt been made to undertake a correlative study of these three groups simultaneously with the same goals as those of the present work.

E. BOLTOVSKOY (1970), based on the Foraminifera of about 3500 samples, has produced schemes on the surface hydrology of the southwestern Atlantic Ocean. Although it appears that the group employed by this investigator is one of the better indicators, it is of interest to compare

his results with the study of other plankters. An important aspect in this type of investigations is that once the principal equalities have been established, they will allow deduction of unknown faunistical parameters based on others already studied.

Evidently this study is not intended to be compared with the work of E. BOLTOVSKOY. This one only includes the central part between the limits of the Malvinas current and the Subtropical-Subantarctic Convergence Zone. However, due to the importance, not only academic but also applied, of the theme in question as well as to the fact that three groups are considered simultaneously, I believe the results to be interesting. It is in line, then, to call the attention of planktologists to the prosecution of this type of studies encompassing other taxa.

In summary, we can synthesize the objectives of this work as: 1. Detection of the hydrological areas on the basis of the interpretation of the three indicator groups; 2. Comparison of the results with the hydrological schemes proposed by E. BOLTOVSKOY (based on Foraminifera); 3. Comparative evaluation of the three taxa with reference to their use as indicators.

Due to the small area sampled and the scarce samples the conclusions obtained may be modified in the future.

MORPHOLOGICAL PECULIARITIES IN SOME OF THE SPECIES FOUND

All the species found have already been described and illustrated. The criteria adopted in the systematic determinations can be found in the works of E. BOLTOVSKOY and the author (see "Literature Cited"). However, some morphological details in certain species differed from the

		Cruise		July 1973						
Taxon	Origin	Station	1	2 ¹	3	4 ¹	5	6 ¹	7	
		Latit. S	40°42'	40°49'	40°54'	41°07'	42°21'	42°21'	42°06'	
		Long. W.	54°44'	53°43'	52°38'	51°52'	49°59'	51°18'	53°51'	
		Species	°C	12.5	15.5	17.8	15.2	15.7	8.0	14.6
Foraminifera	C	1. <i>Globigerinella aequilateralis</i> (Brady, 1884)		X	X	X	X	X		X
	F	2. <i>Globigerina bulloides</i> (Orbigny, 1826)	X	X	X	X	X	X	X	X
	O	3. <i>Globigerina dutertrei</i> Orbigny, 1839			X					
	F	4. <i>Globigerina pachyderma</i> (Ehrenberg, 1873)	X	X	X	X	X	X	X	X
	F	5. <i>Globigerina quinqueloba</i> Natland, 1938				X		X		
	C	6. <i>Globigerina rubescens</i> Hofker, 1956								
	C	7. <i>Globigerinita cf. saratogaensis</i> (Applin, 1925)			X	X	X			
	O	8. <i>Globigerinita glutinata</i> (Egger, 1893)	X	X	X	X	X	X		X
	F	9. <i>Globigerinita uvula</i> (Ehrenberg, 1873)								X
	C	10. <i>Globigerinoides ruber</i> (Orbigny, 1839)	X	X	X	X	X			X
	C	11. <i>Globigerinoides trilobus</i> (Reuss, 1850)	X	X		X				X
	C	12. <i>Globorotalia hirsuta</i> (Orbigny, 1839)	X	X	X	X	X	X		
	F	13. <i>Globorotalia inflata</i> (Orbigny, 1839)	X	X	X	X	X	X	X	X
	C	14. <i>Globorotalia menardii</i> (Orbigny, 1826)		X	X		X	X		
	F	15. <i>Globorotalia scitula</i> (Brady, 1882)		X	X	X	X	X	X	
	F	16. <i>Globorotalia truncatulinoides</i> (Orbigny, 1839)	X	X	X	X	X	X	X	X
	O	17. <i>Orbulina universa</i> (Orbigny, 1839)								X
Pteropoda	C	18. <i>Cavolinia inflexa</i> (Lesueur, 1813)								
	F	19. <i>Clio pyr.</i> f. <i>antarctica</i> Dall, 1908					X			
	O	20. <i>Clio pyr.</i> f. <i>lanceolata</i> (Lesueur, 1813)					X			
	C	21. <i>Creseis acicula</i> (Rang, 1828)								X
	C	22. <i>Creseis virgula</i> (Rang, 1828)								
	C	23. <i>Diacria trispinosa</i> (Blainville, 1821)								
	C	24. <i>Hyalocylis striata</i> (Rang, 1828)								
	C	25. <i>Limacina bulimoides</i> (Orbigny, 1836)								
	F	26. <i>Limacina helicina</i> (Phipps, 1774)					X	X		X
	C	27. <i>Limacina inflata</i> (Orbigny, 1836)					X	X		
	C	28. <i>Limacina lesueurii</i> (Orbigny, 1836)								
	F	29. <i>Limacina retroversa</i> (Fleming, 1823)					X	X	X	X
	C	30. <i>Limacina trochiformis</i> (Orbigny, 1836)								
	C	31. <i>Styliola subula</i> (Quoy et Gaimard, 1827)					X			
Chaetognatha	F	32. <i>Eukrohnia hamata</i> Möbius, 1875								
	C	33. <i>Krohnitta pacifica</i> (Aida, 1897)								
	C	34. <i>Krohnitta subtilis</i> (Grassi, 1881)								
	C	35. <i>Pterosagitta draco</i> (Krohn, 1853)		X			X	X		X
	C	36. <i>Sagitta bipunctata</i> Quoy et Gaimard, 1827			X					
	C	37. <i>Sagitta enflata</i> (Grassi, 1881)						X		X
	O	38. <i>Sagitta friderici</i> Ritter-Zahóny, 1911								
	F	39. <i>Sagitta gazellae</i> Ritter-Zahóny, 1909			X			X	X	X
	C	40. <i>Sagitta hexaptera</i> Orbigny, 1843		X	X	X		X	X	X
	C	41. <i>Sagitta hispida</i> Conant, 1895		X						X
	C	42. <i>Sagitta lyra</i> Krohn, 1853			X			X	X	
	O	43. <i>Sagitta maxima</i> (Conant, 1896)								
	C	44. <i>Sagitta minima</i> Grassi, 1881		X	X	X		X	X	X
	C	45. <i>Sagitta serratodentata</i> Krohn, 1853		X	X		X	X		X
	C	46. <i>Sagitta tasmanica</i> Thomson, 1947	X				X	X	X	X
	C	47. <i>Sagitta tenuis</i> Conant, 1896			X		X			X

Cruise							January 1974							
Station	8 ¹	9	10 ¹	11	12		8	9	10 ¹	11	12 ¹	13	14 ¹	15
Latit. S	43°06'	42°06'	42°06'	41°58'	40°49'	39	39°37'	44°38'	40°30'	41°31'	42°44'	42°42'	41°36'	40°32'
Long. W	53°55'	54°22'	55°20'	55°59'	56°16'	55	52°20'	52°54'	51°36'	51°31'	51°09'	52°16'	54°03'	55°20'
Sp.	°C	14.4	13.1	7.6	6.2	5.1								
							19.2	16.7	18.6	18.0	15.4	15.8	17.8	14.5
1.			X				X	X	X	X		X	X	
2.	X	X	X	X	X	X	X	X	X	X	X	X	X	X
3.														
4.	X		X	X	X	X	X	X	X	X	X	X	X	X
5.			X	X	X	X	X	X	X	X	X	X	X	X
6.											X	X		
7.														
8.			X			X		X	X	X	X		X	X
9.														
10.	X	X					X	X	X	X		X	X	
11.							X	X	X	X				X
12.	X	X	X	X										
13.	X	X	X	X	X	X	X	X	X	X	X	X	X	X
14.														
15.	X	X	X	X										
16.	X	X	X	X	X	X		X	X	X	X	X	X	X
17.								X	X	X	X		X	X
18.						X	X			X			X	
19.									X	X	X			
20.	X								X				X	X
21.														
22.							X			X	Not Sampled			
23.														
24.														
25.	X	X												
26.		X		X		X			X	X			X	X
27.							X			X		X	X	X
28.														
29.	X	X	X	X	X	X			X		X			
30.														
31.														
32.			X	X		X								
33.														
34.														
35.	X	X								X				
36.														
37.													X	
38.							X	X					X	
39.			X	X	X	X			X		X	X	X	
40.														
41.														
42.														
43.														
44.	X	X					X	X	X	X				
45.	X							X						
46.		X	X	X	X	X		X	X	X	X		X	X
47.							X							

[illegible]



previous descriptions and I will briefly point them out. These are:

Limacina helicina (Phipps, 1774). Individuals were found with shells of different height, with the body whorl being more globular in those with higher shells (Figure 1). This phenomenon led to the belief of the presence of two different formae. However, according to VAN DER SPOEL (personal communication) it is actually the same *Limacina helicina helicina*, forma *rangii* (according to the classification proposed by VAN DER SPOEL, 1967).

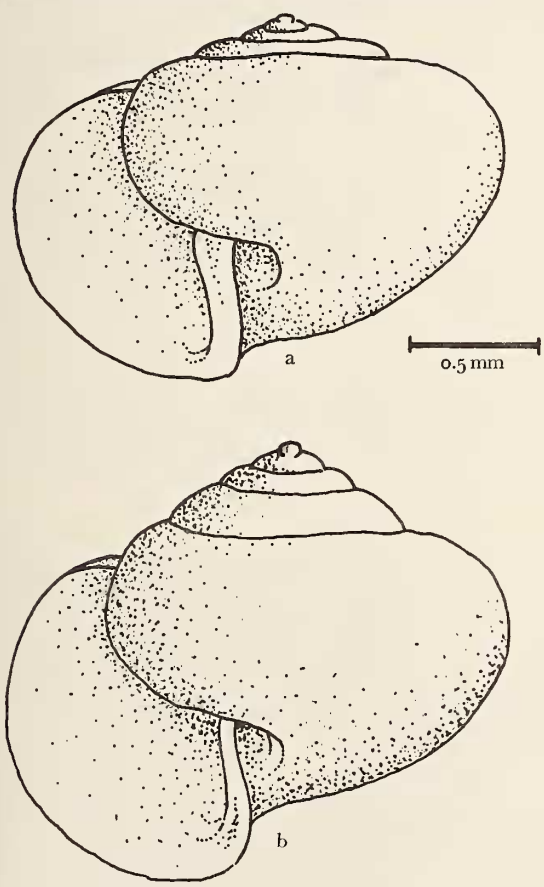


Figure 1

Limacina helicina. a: frontal view of an individual of low shell;
b: frontal view of an individual of high shell

Eukrohnia hamata Möbius, 1875. The collarette of the specimens found was not as short as that described by ALVARIÑO (1969) based on material from the Atlantic, but rather developed and extended from the neck to the seminal vesicles similar to those characteristic of the pop-

ulations of the Pacific studied by FAGETTI (1958).
Sagitta serratodentata Krohn, 1853. A wide variety of different aspects was registered in the seminal vesicles of this species (see D. BOLTOVSKOY, 1973b).
Sagitta tasmanica Thomson, 1947. The polymorphism of this species has been already described in a previous work (D. BOLTOVSKOY, 1974).

VERTICAL DISTRIBUTION
OF THE GROUPS STUDIED

Although no vertical hauls of the stratificate type were made, the available surface sample and the sample between 0 and 50 m from each station permits drawing some general conclusions which result from analysis of Table 2.

A. Foraminifera

Some differences were observed between the diurnal and nocturnal samples (in favour of the last). I do not believe this to be due to daily vertical migrations. This being the case, then there should have been differences between vertical and surface samples. This last phenomenon is not observed in the studied samples. All the percentages maintain uniformity in this sense. Although no quantitative data were included, the numbers indirectly corroborate the thesis of E. BOLTOVSKOY (1973) as to the non-existence of daily vertical migration in Foraminifera.

B. Pteropoda

Evaluation of the respective findings (Table 2) confirm the existence of daily vertical migration in Pteropoda (WORMELLE, 1963). Although these migrations affect a bathymetric interval larger than 0-50 m, they can also be

Table 1

(see foldout)

Data with reference to the stations

- C: Indicators of waters of subtropical origin (warm)
- F: Indicators of waters of subantarctic origin (cold)
- O: Cosmopolitan organisms or not useful as indicators (or both) in the studied zone
- 1: nocturnal station
- °C: surface temperature in degrees Centigrade
- x: positive registry

The first column of each station represents the surface sample for that station; the second column: vertical from 0 to 50m

Table 2

Vertical and diurnal/nocturnal distribution of zooplankton
(all data refer to both cruises)

Hourly limits: diurnal sample: 06.00 to 18.00 hours
nocturnal sample: 18.01 to 05.59 hours

6, 7: cosmopolitan species are omitted from the computations

+ : the numbers correspond to the summation of the positive registries of each species/quantity of corresponding samples

Totals of rows 1 and 2: % with respect to 1 + 2

Totals of rows 3, 4 and 5: % with respect to 3 + 4 + 5

Totals of row 6: % with respect to 6A + 6B

Totals of row 7: % with respect to 7A + 7B

		Foraminifera			Pteropoda			Chaetognatha		
		⁺ Diurnal samples	⁺ Nocturnal samples	Total	⁺ Diurnal samples	⁺ Nocturnal samples	Total	⁺ Diurnal samples	⁺ Nocturnal samples	Total
1	Findings of species in surface samples	5.5	7.1	49.7	0.8	2.3	50.4	1.4	1.7	41.2
2	Findings of species in vertical samples	6.1	7.2	50.3	0.8	2.5	49.6	2.6	2.2	58.8
3	Equal entries in both samples of the same station	4.9	5.5	63.0	0.3	1.5	39.3	1.2	1.3	39.6
4	Cases of species present in surface sample but not in vertical sample of the same station	1.6	1.5	19.3	0.6	0.8	31.0	0.6	0.4	18.0
5	Cases of species present in vertical sample but not in surface sample of the same station	1.3	1.5	17.6	0.4	0.9	27.7	1.4	1.1	42.4
6	¹ Sub- A Findings in tropical surf. samples	1.2	1.5	49.0	0.5	0.9	58.1	1.2	0.8	44.7
	species B Findings in vert. samples	1.4	1.5	51.0	0.4	0.6	41.9	1.7	0.8	55.3
7	¹ Sub- A Findings in antarctic surf. samples	3.4	4.1	49.4	0.2	1.2	43.4	0.5	1.0	39.7
	species B Findings in vert. samples	3.7	4.2	50.6	0.3	1.5	56.6	0.9	1.3	60.3
		$\Sigma = 29.1$	$\Sigma = 34.1$		$\Sigma = 4.3$	$\Sigma = 12.2$		$\Sigma = 11.5$	$\Sigma = 11.6$	

detected within these limits (HSIAO, 1957). On the other hand, the greater abundance of cold-tolerant species rather than warm-tolerant species, corroborate, indirectly, the conclusions that will be presented later about the predominance of subantarctic waters in the zone of the study.

C. Chaetognatha

The net predominance on the captures of vertical over the horizontal hauls with respect to both warm-tolerant and cold-tolerant species becomes obvious. The pronounced difference in yield of all the surface and subsurface samplings against the lack of predominance of nocturnal or diurnal samples, indicate that the daily vertical migrations of Chaetognatha, in this zone, affect very little the surface water column of 50 m and that these

populations occupy, both day and night, the subsurface layers (see HIDA, 1957; ALMEIDA PRADO, 1968; FAGETTI, 1972).

Although the distributive differences could be due, to some degree, to the insufficient number of samples (see "Faunistic Aggregations"), I think that they do reflect the phenomena that really take place in the studied zone. This conviction is supported by the data of the authors previously cited as well as by the evidence gathered during the author's observations.

As a concluding remark of this chapter, we can state that: Pteropoda, as well as Chaetognatha and, to a lesser extent, Foraminifera, in order to use them as hydrological indicators in the area studied, must be sampled with both diurnal and nocturnal samplings, preferably in the same zone; the 0-50 m interval is very homogeneous from a

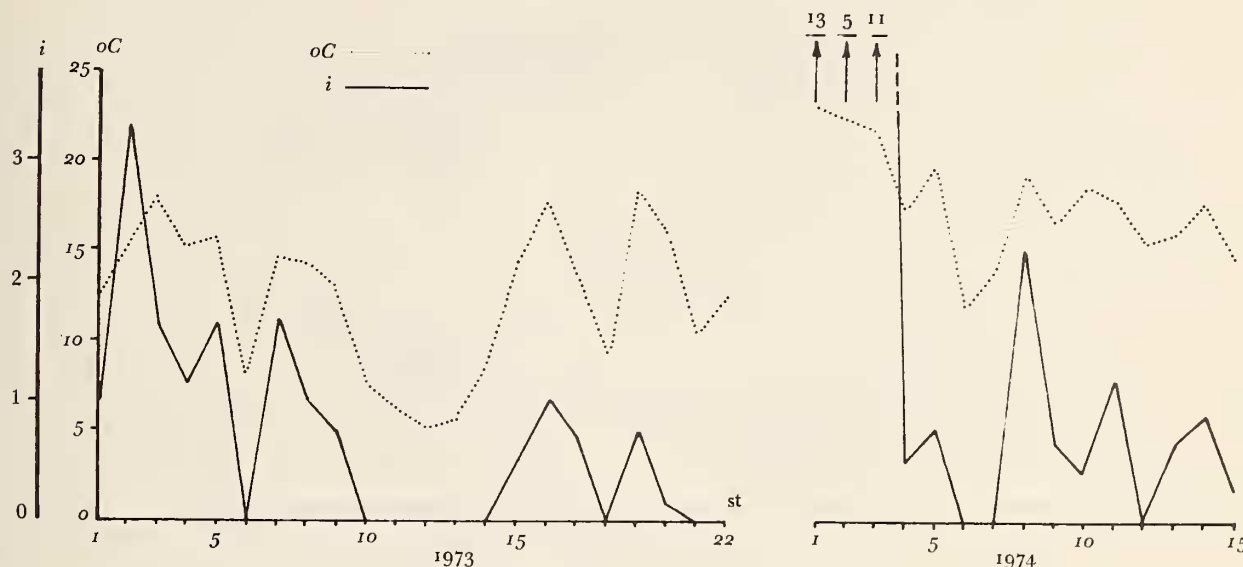


Figure 2

Relation between surface temperature ($^{\circ}\text{C}$) and the index

subtropical species/subantarctic species (i) for each station (st). Note: In those cases where the quantity of subantarctic species was 0, the corresponding index was replaced by the numerator of the formula.

faunistic point of view (no species with more than two findings was exclusive of either horizontal or vertical hauls) but present great hourly differences between the inhabitants of different levels. This last point is important since the majority of the oceanographers consider the superficial waters limited to the 5–10 m of depth (although in major oceanic zonings generally the epipelagic layer is included in the 50–100 m upper zone of water).

RELATIONS TO TEMPERATURE

The relation of temperature with marine organisms is well known. However, this parameter is not the only one affecting the pelagic populations but acts in conjunction with a number of chemical and physical properties of the water. In other words, it varies with characteristics of the environment as well as the geography (KINNE, 1963). For this reason this factor alone is not sufficient to delineate a water mass as far as it is defined as a complex of biotic and abiotic characteristics. However, many oceanographers used it to divide the investigated area (KRÜMMEL, 1911; HART, 1946; etc.).

In view of all this it is of interest to try a parallel between the temperature and the faunistic qualitative com-

position of the analyzed material since it can lead to interesting results (see Figure 2).

A look at the curves (Figure 2) shows the existence of a narrow relation between both parameters, specially in the 1973 samples. However, a more detailed analysis does not corroborate this conclusion. A regression analysis yields quite a low value between the pair of data (July 1973 campaign) studied. The value is 0.34 (the straight of regression is $y = 9.88 + 4.83x$ and the dispersion is 3.18 with a standard deviation of temperature (y) of 1.26).

This phenomena of the discord in the interrelation of the two variables, drawn and calculated analytically, was previously noted by MARGALEF (1967).

It is deduced that a positive correlation exists, but it is relatively low. Maybe more data, obtained on the basis of a higher number of samples, would give a better relation of regression. Perhaps most of the points of Figure 2 that do not fit the curve, must be attributed to reasons other than surface temperature.

Similar procedures to those used in this case can be developed to expose other abiotic variables with the biotic differences studied.

Also these considerations constitute a new corroboration of the opinion of the majority of the scientists, who work with hydrological indicators, that construction of

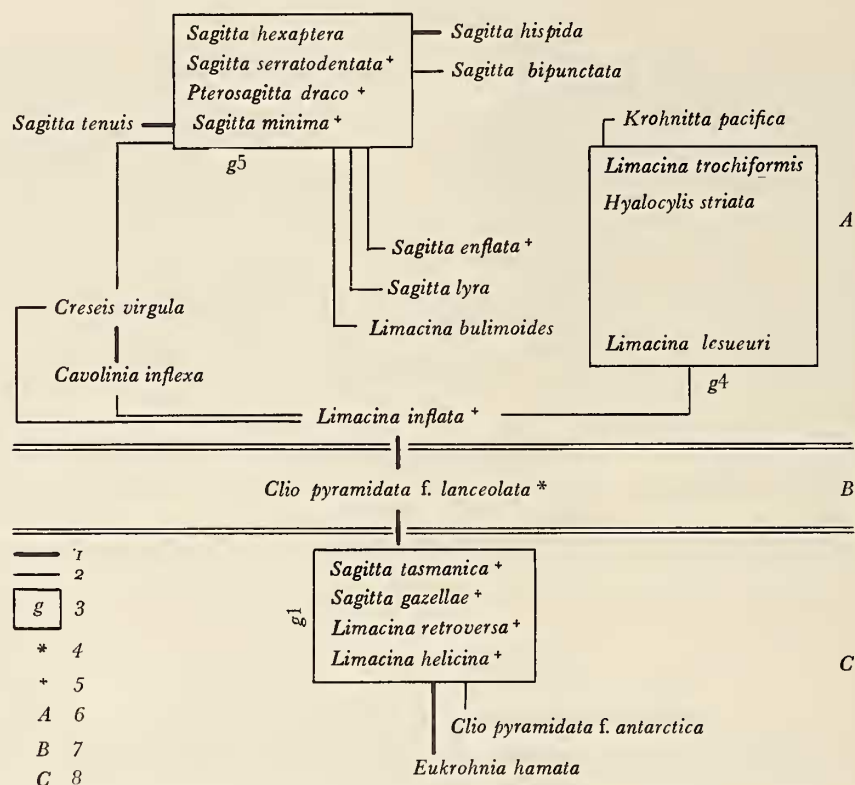


Figure 3

Faunistic groupings in Pteropoda and Chaetognatha

- | | |
|---|---------------------------------------|
| 1) Affinity (in the groups with at least one integrant of the same) of level 0.4 and more | 5) Species common in the sampled zone |
| 2) Affinity of level 0.3 through 0.4 | 6) Subtropical species |
| 3) Recurrent groups | 7) Cosmopolitan species |
| 4) Non-indicator species | 8) Subantarctic species |

any pelagic dynamic zoning is incorrect if based on temperature only.

FAUNISTIC GROUPINGS

The phenomena of association of species is well known in groups which owe their coexistence to similar ecological requirements or to some other factor, e.g., trophic relationship. The detection of these groups is important because of the possibility of their use as indicator-complexes of different environmental abiotic or biotic conditions, or both.

To perform such an analysis on the material studied, the method proposed by FAGER (1957) was used. It con-

sists in the composition of recurrent groups, utilizing, to calculate the index between each pair of species possible, the formula of FAGER & MCGOWAN (1963):

$$\frac{J}{\sqrt{N_A \cdot N_B}} - \frac{1}{2 \cdot \sqrt{N_B}}$$

Where J is the number of joint occurrences of Species A and B; N_A is the total number of occurrences of species A and N_B is the total number of occurrences of species B. Species are assigned to the letters so that $N_A \leq N_B$.

The results obtained were based on both campaigns jointly.

In Figures 3 and 4 the found relations are represented and the affinity distributions are in accordance with the empirical observations on the known material, with some particular adjustments. The graphs were made in such